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STUDY TITLE: PLANNING ALTERNATIVES FOR NAVAL AIRCRAFT GUN SYSTEM ACQUISITION

STUDY PROJECT GOALS: To outline OSD standardization direction which has been promulgated in order to present the intent and rationale.
To compare this with present and developmental systems.
To identify potential options for Naval air applications.

STUDY REPORT ABSTRACT:

→ This report provides examples of the services' sometimes responding to too specific requirements with resultant limited system adaptability. The report then chronologically presents the OSD guidance and the services' response on gun and ammunition standardization. The increasingly definitive direction emanating from OSD rather effectively narrows the options available to the services. The calibers and families of ammunition to be used are defined and candidate guns are defined.

The report concludes that the Navy needs to define its requirements and examine them in comparison with current OSD direction. Recommendations are then made that the Navy get involved in joint service programs where indicated.

KEY WORDS

MATERIEL

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NAME, RANK, SERVICE
Leonard E. Young, Jr., GS-13, DNC

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PROGRAM MANAGEMENT COURSE INDIVIDUAL STUDY PROGRAM

PLANNING ALTERNATIVES
FOR
NAVAL AIRCRAFT GUN SYSTEM
ACQUISITION

STUDY PROJECT REPORT
PMC 76-1

Leonard E. Young, Jr.
GS-13 DNC

FORT BELVOIR, VIRGINIA 22060

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EXECUTIVE SUMMARY

The services' have developed gun systems to meet very narrow requirements which have often precluded their effective adaptation to other applications.

The OSD has become increasingly more interested in the overall problem of gun and ammunition standardization and has promulgated directives which have evolved from requests to ultimatums.

The most recent spectrum of gun and ammunition alternatives offered is narrow, but reasonable, if options are carefully examined and considered with respect to realistic requirements and in consideration of potential multiple applications. The possibility does exist, however, that modifications to the alternatives offered may be required.

The Navy should define, coordinate, and be prepared to defend its gun and ammunition requirements in relation to future individual aircraft. The Navy should also take the initiative in participation in joint service programs.

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Background

Historical examination readily reveals that the services have developed numerous medium caliber (i.e. 20mm to 40mm bore size) guns and associated ammunition to satisfy very specific requirements. This has occurred on many occasions without appreciable consideration for other potential applications in the same service or potential requirements in other services for a similar system. Evidence of this approach may be found throughout current service inventories and also may be found in recent or current development programs. An example of the former case is the 20mm M61 gun (in various configurations) and the M50 configuration ammunition. The latter case is represented by the 30mm GAU-8 gun and ammunition system developed exclusively for the A-10 aircraft. These two cases will be addressed in the following paragraphs.

The basic 20mm M61 gun with ammunition was developed for high altitude, close range, air-to-air combat. This system, although still used in the design role, has and is being employed in many different configurations and other roles. It often suffers considerably degraded performance when used in other than the design role (e.g. air-to-surface, surface-to-air). The degraded performance may be directly traced to the originally designed performance requirements for the ammunition. Although the gun, per se, performs and surpasses original goals, the ammunition performance characteristics, in terms of time of flight and terminal effects, do not meet current requirements (1)¹ in view of the state-of-the-art.

¹This notation will be used throughout the report for sources of referenced material. The number represents the corresponding number in the Bibliography.

The 30mm GAU-8 gun and ammunition system was developed for the Close-Air-Support mission (i.e. air-to-surface). The overall system is intended to defeat heavy (armored) surface targets and softer targets in support of Army ground forces. The system, although meeting stated requirements, is so heavy and bulky as to be virtually unuseable in other aircraft applications. To date, it has not been chosen for any surface applications either.

The foregoing does not imply that concern for proliferation has not existed or does not exist. It does, however, point out that the economics of the problem of dedicated systems have not been an overriding factor and that multiple systems have been allowed as necessary, affordable and required to meet all contingencies. Another factor that unquestionably has contributed to development of many different systems is interservice rivalry. In some ways, this is now less of a problem but in others it is not diminished. To illustrate, it is less of a problem due to the closer joint service involvement and coordination of programs due to groups such as the JTCG/ALNNO:WPFG (Joint Technical Coordinating Group/Air Launched Non Nuclear Ordnance:Working Party For Guns). For the opposite case, the greater competition for a portion of the shrinking RDT&E (Research, Development, Test and Evaluation) budget has driven the services to compete for programs if for no other reason than to maintain their capability to perform in a given area of expertise. It should be mentioned that interservice competition has on occasion, resulted in the fielding of superior systems by this country. The attendant penalty of duplication of effort has sometimes existed.

Details of OSD Direction and Services' Response

Although the OSD (Office of the Secretary of Defense), has been interested in standardization of medium caliber guns and ammunition for many years, the current trend of emphasis in this area began during the mid-sixties. The directives issued and the services' responses provided the foundation upon which much of the subsequent direction and action has been built. The interchange of directives, responses, and actions will be chronologically traced below in an attempt to point out trends.

In 1966, DDR&E (Director, Defense Research and Engineering) issued a memorandum (2) addressing a shortage of 20mm ammunition for use by the Air Force in SEA (South East Asia). The fact that Navy stocks of 20mm ammunition could not be substituted due to differences in design (e.g. size) was also addressed. Concern for commonality of guns and ammunition in current and future programs was expressed and a review of and report on the situation in 20mm to 30mm programs was requested. The initial response (3) of the services was limited to a study of 20mm systems and primarily those already in inventory. A variety of recommendations was provided but it was apparent that the problem was difficult (i.e. the ability to effect change is severely constrained after numerous systems are deployed). Subsequently, a second response (4) was provided which addressed the services' collective requirements in various calibers from 20mm to 30mm. This was the first attempt to generate a JSOR (Joint Services Operational Requirement) in the gun and ammunition area. The next response to the DDR&E memorandum was intended to complete the response to the original request. It was a JTDP (Joint Technical Development Plan) (5) which identified, with some omissions, the developments which were underway in

order to fulfill the requirements of the JSOR. It should be pointed out that all of the responses (i.e. the study, the JSOR, and the JTDP) were prepared by the JTCG/ALNNO:WPPG which was chartered (6) to (a) insure interservice awareness of Research and Development programs, (b) recommend reorientation to insure maximum utilization of resources and (c) consolidate approaches toward meeting similar or related requirements. In February 1969, DDR&E established the AMRAD (Air Munitions Requirements And Development) Committee (7) to recommend joint use requirements and advise on matters of standardization. This committee was established partially because of insufficient progress toward standardization and would play a role in standardization efforts in the years to come. The JSOR and JTDP were reviewed extensively and were intended to provide the beginnings of a method for attempting to accomplish tri-service coordination to achieve standardization. However, the JTDP was informally criticized as being a "shopping list" of everything that the services wanted. This was considered to be due to the JSOR which was really a compilation of individual service requirements. In June 1970, a DDR&E memorandum stated:

. . . review of the current JSOR and JTDP has lead to the conclusion that the basic problem appears to be the rigid definition of qualitative requirements contained in the JSOR. This tends to inhibit the convergence of requirements by the technical evaluators, thereby limiting the number of items that can be identified for potential common use by two or more Services. It appears that a solution to the problem may be in introducing the Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance (JTCG/ALNNO) into the planning process prior to the preparation of an Inter-Area R&D Coordinating Paper, Program Memoranda, or Joint Service Operational Requirement for guns. Our previous attempts to prepare the necessary documentation for the establishment of guidance to develop weapons that are joint useable have not taken full advantage of the technical capabilities within the JTCG/ALNNO.

A feasibility analysis, to converge qualitative requirements where practical and identify potential common use weapons, prepared by the JTCG/ALNNO Working Party for Guns and Ammunitions prior to defining rigid qualitative requirements should be undertaken. (8)

The WPGF did prepare a document (9) in response to the above direction. Once again, tri-service agreement was reached and every program that was ongoing was considered to be necessary. The only convergence of requirements appeared to involve proposed programs which had not yet been approved and funded. The "shopping list" remained basically intact. The realization had not yet occurred that everything desired by everyone could not be afforded and would not be allowed.

It is significant that from this time forward, the direction promulgated by OSD became more detailed and specific. It is also significant that the services were seldom requested to perform any further exercises with the objective of attaining standardization on their own. In retrospect, the underlying reasons are fairly obvious: 1) there had been no appreciable progress made toward standardization and 2) Congressional pressure (10) was being brought to bear on the problem.

The next policy direction was issued by Deputy SECDEF and gave specific guidance:

Ammunition cost is the controlling economic factor throughout the lifecycle of surface and aircraft weapons incorporating automatic cannons. Furthermore, there are vast supplies of medium caliber ammunition already stockpiled for existing systems. With new and different gun systems entering the inventory, it is mandatory that controls be established to preclude further proliferation. Accordingly, it is my intention to standardize medium caliber ammunition to the greatest degree feasible.

All developments and procurements for conventional cased ammunition in the 20mm to 40mm caliber range for surface and aircraft weapon systems will be in 5mm increments beginning with 20mm. Only a minimum number of standard

rounds in each caliber will be selected. Interchangeability of rounds within a standard caliber is required. (11)

This policy memorandum effectively curtailed one previously used mechanism for justifying new programs (e.g. 20mm will not do the job, therefore a 23mm must be developed). In essence, the memorandum implies that if a certain caliber will not satisfy requirements, the option is to move to the next larger approved caliber. This memorandum addressed only ammunition and did not specifically address or impose constraints on gun systems development. Of significance is the fact that even though controls were imposed, they were not overly restrictive (i.e. they were completely reasonable). For this reason, there was no cry of protest and the services accepted this policy. The policy also applied to new nonconventional ammunition programs, such as the LPG (Liquid Propellant Gun) exploratory development program. However, the requirement for interchangeability was not imposed due to the unknowns still associated with high technology efforts.

The next OSD memorandum (12) on guns and ammunition addressed standardization goals for these types of weapons. Excerpts from the memorandum and comments follow:

. . . a review has been conducted of total stated requirements of the Services for automatic cannons and their ammunition systems.

Based on this review it appears that the DOD ammunition and gun inventory can be purified over a period of years to significantly enhance the DOD logistic support situation.

.
The following discussion outlines a proposed program for achieving the OSD standardization goals for medium caliber gun/ammunition systems.

Evidence that the review had been thorough was contained in the two attachments to the memorandum. These attachments listed all of the guns

and ammunition considered. Virtually all inventory and developmental systems were included and then categorized as existing, interim, and future (e.g. goals). The memorandum then provided a policy statement.

Policy - To insure that development of guns and ammunition receive the same management attention as is given to major weapon systems, the development of gun weapon systems that utilize conventional ammunition is to go forward in accordance with pertinent Department of Defense Directives and Instructions. If these system developments envision using ammunition other than Service qualified, then the development of such systems and the ammunition will come under the same management review process called out for major weapon systems in Department of Defense Instruction [Directive] 5000.1.

This policy is significant in that most medium caliber gun systems do not meet the 50 million dollars in RDT&E threshold. Also they generally do not meet the 200 million dollars in production threshold for initially planned systems. However, over their life cycles, with multiple applications, their total production costs can dwarf the production threshold. This is particularly true for the ammunition. This factor probably influenced the policy guidance decision to impose DOD Directive 5000.1. (13) The memorandum continued and specifically addressed ammunition and then guns and proposed rather specific candidates for each bore size.

Ammunition - Primary emphasis should be placed on reducing the numbers of ammunition types to the minimum consistent with Service requirements. As indicated on Attachment 1, the existing families of ammunition could readily be reduced to four,

.....
would then include (1) the improved 20mm M50 series, (2) improved 20mm Hispano series (as an interim to be replaced by a new 25-30mm case, caseless, or telescoped family), (3) the 30mm ammunition used with the GAU-8 and GAU-9 guns, and (4) the 30mm WECOM 30.

Automatic Cannons - Even though the cost savings and logistic support issues are less severe with the proliferation of guns than with associated ammunition, minimizing the number of automatic cannons in the inventory is very important.

Thus a minimum family of weapons could satisfy the Services' automatic cannon requirements namely: the (1) 20mm M61 Gatling (2) 25-30mm new Gatling, (3) 25-30mm new externally powered, single barrel cannon, (4) 30mm GAU-8 cannon, and (5) 30mm WECOM 30 (external powered).

The memorandum continued and provided further rationale for the controls being imposed.

With regard to both automatic cannons and ammunition, NATO standardization is becoming increasingly important and will strongly influence future procurement.

Accordingly, it is requested that the Services acting in consonance with the ASD(I&L) and DDR&E, provide their comments and recommendations to accomplish the following goals as described above:

- (1) Reduce automatic cannon types to no more than five.
- (2) Reduce automatic cannon ammunition types to no more than four.
- (3) Investigate potential for joint Service development (within prescribed DSARC process) of a 25-30mm gun/ammunition system.

It is interesting that the WFFG was never tasked to comment on this memorandum. The direction concerning the reduction in gun and ammunition types still provided enough flexibility that it was difficult to do anything other than agree. However, investigation of the potential for joint Service development of a 25-30mm gun/ammunition system is typical of the type of effort that the WFFG would normally have been tasked to accomplish. Although no investigation was accomplished further guidance was issued which effectively designated the ammunition which would be used in any such program.

. . . . the Oerlikon 25mm family of ammunition developed for the Army's VRFWS (Bushmaster), is designated as the U.S. Services standard 25mm ammunition. There will be no deviation from this 25mm family of ammunition to other configurations of the same caliber without compelling operational and economic justification. (14)

The issuance of this policy guidance effectively completed the definition

of the choices of ammunition configurations in the 20mm to 30mm range.

Since larger bore sizes (e.g. 35mm and 40mm) are generally considered to be too large for aircraft application, the constraints which have been imposed are sufficient to prevent further ammunition proliferation.

Directed Alternatives and Options Available

Ammunition

The foregoing defines four specific families of ammunition which may be employed in future gun systems. Each of these will be identified and briefly described below (additional information on various gun systems may be found in Appendix I).

The 20mm M50 configuration ammunition is a NATO standard and is used by all of the United States Services. It was developed for use in air-to-air combat but has been and is being used in all other roles.

The 25mm Oerlikon family of ammunition has been chosen for the Army's BUSHMASTER program. This application is specifically surface-to-surface but it has now been designated for use in all other roles in which a 25mm system will be employed.

The 30mm GAU-8 ammunition family was developed for the A-10 aircraft. The primary mission of this aircraft is Close-Air-Support, therefore the ammunition was designed for air-to-surface usage. This is the only current application even though it has been designated as the standard.

The 30mm "WECOM 30" family of ammunition was initially developed by the Army for the Cheyenne helicopter program. After cancellation of this program, it was chosen for the AAH (Advanced Attack Helicopter) program. This is the only intended application of this ammunition and it is a recognized exception to the single family of ammunition in each caliber.

Guns

The direction on guns, although restricting the total number to five, was not as specific with regard to the particular choice as was the case with ammunition. The five areas of direction will be individually

addressed below.

The 20mm M61 Gatling is the indicated choice as it is currently used by all the services even though its configuration varies between individual systems.

The 25mm to 30mm new Gatling is not very restrictive direction. However, the designation of the standard 25mm round and the consideration that the 30mm GAU-8 is a Gatling mechanism rather effectively bounds the choices for this candidate system (i.e. a 25mm Gatling mechanism).

The 25mm to 30mm new externally, powered, single barrel cannon will undoubtedly be the 25mm gun chosen for the BUSHMASTER program. Since competition exists, the final gun cannot yet be identified.

The 30mm GAU-8 cannon is the obvious candidate since it and its ammunition were specifically chosen as the standards for 30mm.

The 30mm "WECOM 30" (external powered) is not yet defined since competition exists between candidate guns. The gun which is chosen, like the ammunition, is intended for a single application.

Analysis of Alternatives and Options

Each caliber will now be addressed, in turn, and comments will be addressed to both guns and ammunition.

20mm Guns and Ammunition

The choice of the M50 configuration ammunition is entirely logical, however, the present design has recognized deficiencies in both exterior ballistics characteristics and fuze sensitivity. These problems, although directed to be resolved (15), remain. If this ammunition is to provide the performance required (1), these problems must be resolved.

The choice of the M61 Gatling gun is obvious, however, there may be applications which do not require the rate of fire of this gun and which cannot provide the volume required to house this system. For this reason, a single barrel, low rate of fire 20mm gun may be indicated.

25mm Guns and Ammunition

The 25mm Oerlikon family of ammunition adequately provides the general performance characteristics considered desirable for this caliber. However, the specific types of rounds presently available are insufficient if this ammunition is chosen for aircraft application (e.g. the armor penetrating round utilizes a discarding sabot which would cause FOD (Foreign Object Damage) to the engines of forward-firing aircraft).

The allowance of a new 25mm Gatling mechanism is interesting in that both the Air Force and Navy have informally expressed interest in such a weapon, however, no formal requirement exists. The Army is proceeding with the development of single barrel mechanisms with competing contractors.

30mm Guns and Ammunition

The 30mm GAU-8 family of ammunition provides a high performance round

which will probably be chosen for other applications.

The primary problem with the GAU-8 gun system is its weight, volume, and power requirements (i.e. hydraulically driven). It is likely that a single barrel, low rate of fire weapon will eventually be required due to the inability of many types of weapon platforms to accommodate a system such as the GAU-8.

The "WECOM 30" ammunition was developed to provide low recoil forces due to requirements of the helicopter platform. Further constraints were placed on the ammunition due to the type of warhead chosen. The net effect is that the exterior ballistics characteristics are such that most forward firing, fixed wing aircraft cannot obtain sufficient sight depression to use this ammunition.

The gun which will be chosen to fire the "WECOM 30" ammunition will be rather academic due to the limitations imposed on the overall system by the ammunition.

Liquid Propellant Gun

The LPG program is currently in exploratory development under Navy sponsorship. This program is pushing the state-of-the-art and offers substantially improved performance if successful. However, introduction of service hardware from this program should not be expected prior to the mid-eighties. This is due to funding limitations and also reluctance to accelerate the program because of the danger of getting ahead of the developing technology.

Considerations Applying to All Alternatives and Options

Many considerations should be involved in the selection of a particular gun weapon system for a specific aircraft application. These

same or similar considerations apply to applications such as an Army vehicle or Navy ship installation. The following paragraphs will address some of these considerations.

Performance Considerations

The role and mission of the weapons platform should be an important consideration in the choice of the gun system and ammunition. For example, if on the one hand, the platform is an attack aircraft, primary role air-to-surface, then the ammunition should reasonably be expected to have exterior ballistics characteristics which allow sufficient stand off for aircraft survivability while still providing sufficient projectile kinetic energy, at range, to allow penetration by an armor piercing round or fuze initiation and detonation of a high explosive round. If on the other hand, the platform is a fighter aircraft, primary role air-to-air, then the ammunition should reasonably be expected to provide short time of flight to target because of extremely limited time on target and to provide appropriate terminal effectiveness characteristics (e.g. high explosive detonation and fire start capability). The air-to-air role also demonstrates the importance of the rate of fire of the gun system because of its sensitivity to this parameter. The short time on target dictates the requirement for a high density of projectiles per unit time in order to obtain an acceptable probability of hit.

A multi-mission aircraft, and most are to a degree, must be able to perform in both roles with the probability of some compromise. For example, the choice of a 25mm system may provide adequate gun system performance but degraded aircraft performance while the reverse situation might be true if a 20mm system were chosen. Therefore, the gun system

should not be arbitrarily chosen just because it is available nor should it be ignored because it requires development. The effectiveness of the overall aircraft weapon system should drive the choice. In this regard, the choice of the weapons suit for a given aircraft should probably receive greater attention. Cost effectiveness studies between categories of weapons (e.g. gun systems compared to cluster munitions) might offer information that would influence the choice of armament for a particular aircraft. The cost effectiveness studies most frequently conducted tend to compare weapons of the same type and may not be providing the necessary insight into the weapons selection process. This does not imply that a variety of weapons is not desirable but that periodic reexamination of weapons employment may reveal a more affordable means of defeating a given target or class of targets.

Another consideration which should not be overlooked is that once the decision is made to utilize an internal gun system, it becomes an integral part of the aircraft and is always carried as opposed to weapons which are subject to choice depending on the particular mission. From this point of view, it is extremely desirable that it provide maximum benefits and should therefore be carefully chosen. An additional consideration in the choice of future aircraft gun systems is the advancing state-of-the-art of aircraft themselves. With the potential offered by fly by wire and inherently unstable aircraft (i.e. the ability to fly in an orientation displaced from the velocity vector), the performance required of the gun system may be diminished due to the enhanced ability of the aircraft to acquire and remain on target.

Ammunition Cost Considerations

The cost implications of the choice of a particular round of ammunition can be substantial. Economies of medium caliber ammunition production are not realized until large quantities (e.g. one to several million) are produced per unit time (e.g. one month). Therefore, a round unique to a particular system, is going to be comparatively expensive. This consideration is not always fully appreciated by the program manager for the weapon platform because ammunition is sometimes developed and procured via separate channels (i.e. someone else's problem). In addition to production cost considerations the quantity of ammunition required to be maintained in inventory as war reserve must also be considered. Each different ammunition configuration peculiar to a particular gun system requires separate supply pipelines. An associated penalty of a peculiar configuration is the inability to draw on the stocks of others (e.g. services). The life cycle cost implications of this type of situation are enormous.

Gun System Cost Considerations

The choice of an existing gun system has advantages from the point of view of development cost, established spare and repair parts production lines and supply pipelines. The decision to develop a new unique gun system has significant cost implications due to the fact that expenses are not shared by a variety of users. Therefore, one of the first questions that should be considered, investigated, and answered in the consideration of a requirement for a new gun system is whether the same or similar requirements exist in one's own or other services. The ability to be employed in multiple applications, almost certain to be required

prior to approval to go ahead, has the added potential advantage of sharing the costs involved.

Schedule Considerations

The planned availability date of an aircraft can and should play a substantial role in the choice of a gun system. This is because the development of a new gun system can take as long or longer than the development of a new aircraft. Therefore, the decision on whether to use an existing or new gun system for an aircraft must be made early and should be based on trade-off studies conducted coincidentally with the selection of aircraft performance requirements.

Another factor which should be considered is that if the decision is made to go with a new gun system, time will be required to obtain approval.

Conclusions

Increasing attention is being given to the problem of gun and ammunition standardization. This is apparent from the policy guidance that is being issued. The policies are limiting the numbers of systems that will be allowed and imposing closer scrutiny on those that are allowed.

In this environment, it would appear prudent for the Navy to examine its existing requirements and anticipated or possible needs in the 20mm, 25mm, and 30mm gun systems area and to compare these with systems which have been sanctioned by OSD (specifically the 20mm M61 Gatling gun, the 25mm new Gatling gun, the 30mm GAU-8 gun and the LPG). The requirements and availability of each aircraft currently envisioned should be analyzed against each of these gun systems. The analysis should consider the gun system in relation to the selection of other potential weapons and the optimum weapons suit should be defined. It is emphasized that this type of approach should be individually applied to each aircraft. This is considered to be more in order than ever with the current trend toward cheaper, less capable aircraft, the hi-lo mix concept. This conceptual approach demands a more concerted effort to realize the maximum return on each dollar invested.

Another reason for clear definition of specific requirements for each individual aircraft is that increasing attention to each life cycle cost contributing weapon system can be anticipated. The intuitively obvious solution to this anticipated situation is to completely justify the choices made and the approach taken.

Recommendations

It is recommended that positive steps be taken to clearly define future naval aircraft gun system needs. These should then be compared with the options presently available or allowable as developments. Where development is indicated, initiative should be exercised to determine other similar or related needs. If other needs do exist, a joint program should be actively sought. If other needs do not exist, the Navy must, of fiscal necessity, place their singular need in a priority ranking and proceed accordingly. This, of course, assumes coordination with OSD.

It is further recommended that the Navy take the initiative to achieve joint service endorsement of and participation in the LPG (Liquid Propellant Gun) program. Such positive action, on the part of any service, may help foster interservice coordination and cooperation and help to dispel the perception of continuing interservice rivalry. The result of such an approach would probably be of mutual benefit to all of the services.

BIBLIOGRAPHY

1. NAVY OR-TW38, 24 February 1976, Air-to-Surface Attack 20mm Ammunition.
2. Director of Defense Research and Engineering Memorandum, 3 June 1966, for the Assistant Secretaries of the Services (Research and Development), 20mm Guns and Ammunition.
3. Study to Minimize Number of Gun Mechanisms and Related Ammunition, 29 August 1966, by the Joint Technical Coordinating Group/Air Launched Non Nuclear Ordnance: Working Party For Guns.
4. Joint Services Operational Requirements, 1 March 1968, by the Joint Technical Coordinating Group/Air Launched Non Nuclear Ordnance: Working Party For Guns.
5. Joint Technical Development Plan, 1 June 1968, by the Joint Technical Coordinating Group/Air Launched Non Nuclear Ordnance: Working Party For Guns.
6. Chairman, Joint Technical Coordinating Group, 28 October 1964, Joint Technical Coordinating Group for Air Launched Non Nuclear Ordnance.
7. Director of Defense Research and Engineering Memorandum, 17 February 1969, Standardization of Air Munitions Configuration.
8. Director of Defense Research and Engineering Memorandum, 29 June 1970, for the Assistant Secretaries of the Services (Research and Development), Elimination of Unwarranted Duplication in Gun and Ammunition Development Programs.
9. A Feasibility Analysis for Convergence of Qualitative Requirements Where Practical for Guns and Ammunition and Identification of Potential Common Use Weapons, JTCG/ALNNO, 24 January 1972.
10. Air Munitions Requirements and Development Committee Memorandum, 1 November 1973, for the Assistant Secretaries of the Military Departments (Research and Development), Senator Thurmond's Request for Information on Service Gun and Ammunition Programs.
11. Deputy Secretary of Defense Memorandum, 10 January 1974, for the Secretaries of the Military Departments, Standardization of Medium Caliber Ammunition for Automatic Cannons.
12. Office of the Secretary of Defense (Director of Defense Research and Engineering and Assistant Secretary of Defense (Installations and Logistics)) Joint Memorandum, 11 May 1974 for the Secretaries of the Military Departments, Standardization Goals for Medium Caliber Automatic Weapons.

13. Department of Defense Directive 5000.1, 22 December 1975, Acquisition of Major Defense Systems.
14. Deputy Secretary of Defense Memorandum, 27 June 1975, for the Secretaries of the Military Departments, Standard Medium Caliber Ammunition.
15. Office of the Secretary of Defense (Director of Defense Research and Engineering and Assistant Secretary of Defense (Installations and Logistics)) Joint Memorandum, 20 February 1974, Product Improvement Program (PIP) for M50 Series 20mm Ammunition.

APPENDIX 1

Brief Descriptions of Various Gun Systems

20mm M61 Gatling. This is a six barrel high rate of fire weapon capable of fire from 3000 to 7200 rounds per minute. The rate of fire is subject to choice and is dependent upon the drive mechanism (i.e. hydraulic, gun gas, electric). This gun fires 20mm M50 configuration ammunition.

25mm New Gatling. At present, there is no gun nor is there a development underway to provide a gun meeting this description. A 25mm Gatling gun could be developed to fire 3000 to 6000 rounds per minute depending upon performance requirements and weight and volume limitations. However, such a gun is allowed within OSD guidance. The constraint placed upon it is that it would have to fire the Oerlikon 25mm family of ammunition developed for the Army Bushmaster program.

25mm "Bushmaster". This gun although not yet chosen from competing models will be either a self-powered or externally powered single barrel weapon capable of no more than 1000 rounds per minute. It will fire the Oerlikon 25mm family per OSD direction.

30mm GAU-8 Gatling. This gun, developed for the A-10 aircraft, is a high rate of fire, externally powered (hydraulic), seven barrel weapon which fires 4000 rounds per minute. The ammunition for this gun was developed concurrently with the gun and has been designated the standard 30mm configuration.

30mm "WECOM 30". This gun development was initiated to arm the Army Cheyenne helicopter. Although the Cheyenne was cancelled, the gun development continued and was chosen for the AAH (Advanced Attack Helicopter). There are two competing guns to fire the round of ammunition. Current considerations within OSD render the eventual fate of this gun and its ammunition questionable, specifically, a NATO configuration which is similar, may be the ultimate choice, which would require that the guns be rechambered.

LPG (Liquid Propellant Gun). This gun system concept is currently in Exploratory Development under Navy sponsorship. The program, for aircraft application, is geared toward a multi-barrel high rate of fire 25mm weapon. This program is not expected to provide a useable weapon prior to the mid-eighties time frame.